INSTRUCTION BOOK

No. 3004

537.7
F77
REMOTE STORAGE

TYPE K

INTEGRATING METERS.

FORT WAYNE ELECTRIC WORKS
(INCORPORATED)
FORT WAYNE, INDIANA.

August 22, 1900.

INSTRUCTION BOOK.

Type K Integrating Wattmeter.

The type K single phase alternating current wattmeter, manufactured by the Fort Wayne Electric Works, is of the induction type and is especially designed to register accurately the energy of alternating current circuits regardless of the power factor.

The meter is light and substantially constructed; all parts standard and interchangeable.

All meters for lighting and power circuits will be furnished in the regular standard black Japan finish and of the design in Fig. 1, unless otherwise specified.

The separate sealed connection pattern, as shown in Fig. 2, is designed for Canadian service, but will be furnished to parties specifying them. In this meter the external connections are sealed under a separate seal and independent of the seal used in sealing the cover.

The switchboard pattern is especially designed for switchboard service, being provided with back connections and secured to the board from the back. The meter is enclosed in a dust proof glass case giving the instrument a neat appearance. The meter is furnished in either polished brass, nickel or oxidized finish, as desired by purchaser. The

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polished brass finish will be furnished unless otherwise specified.

The meter will register accurately on any voltage, that is within 25 per cent. of rating. The meters are rated in the standard voltages—50, 100, 200, 220, 500, 1,000 and 2,000 volts. On all voltages above 220 a small transformer is used in the shunt or voltage circuit.

The series coils of meters from 3 to 300 amperes capacity are connected direct to the circuit for voltages not exceeding 2,500 volts. For voltages exceeding 2,500 volts and ampere capacities exceeding 300 amperes, series transformers are used.

In ordering meters state ampere and volt capacity desired also state the number of cycles or the rate of alternations of the circuit to which the meter is to be connected.

FIG. 1.

STANDARD FORM TYPE K METER.

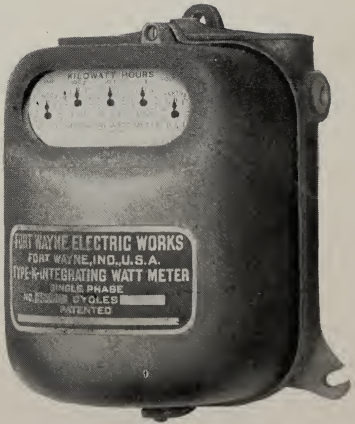


FIG. 2.

SEPARATE SEALED PATTERN

TYPE K METER.

INSTALLING STANDARD FORM TYPE K METER.

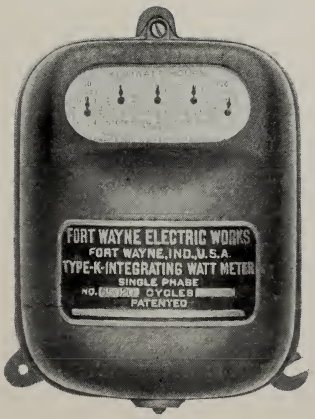
Do not handle the meter roughly. In unpacking and handling the meter care should be taken to avoid subjecting it to any unnecessary jar or vibration. In moving the meter from place to place raise the jewel post nut, which will lift the rotating parts off the jewel.

In setting up the meter, place a screw in a solid perpendicular support and hang the meter by the top lug. The meter should be carefully leveled before the screws in the lower lugs are set.

To level the meter, lower the jewel post nut allowing the rotating parts to rest on the jewel; place a small coin or weight near the edge of the aluminum cup and adjust the position of the meter until the weight remains in any position given it. The weight used in leveling should be non-magnetic or its position will be influenced by the permanent magnet.

When leveled connect to the circuit according to the diagram of its class, taking care to secure a good contact with the circuit wires.

IF THE METER IS PROPERLY CONNECTED IN CIRCUIT THE ARMATURE WILL ROTATE IN A POSITIVE DIRECTION (CLOCK WISE) WHEN LOOKING FROM ABOVE.



STANDARD FORM TYPE K METER.

INSTALLING SEPARATE SEALED PATTERN TYPE K METER.

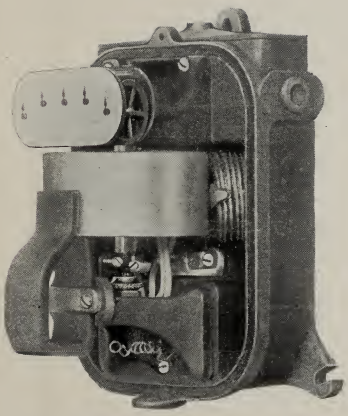
The same care should be taken in unpacking and handling as exercised with the Standard Form of type K meter.

The design of the meter permits the connecting of the meter in circuit without entering the meter proper.

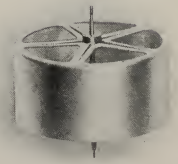
To prepare the meter for installing, take off the cover and remove the small wooden wedge from under the jewel post nut, and screw the nut down firmly to avoid its loosening when the meter is handled. In handling, care should be taken to carry the meter upside down or in a horizontal position, as in these positions, there is no danger of damaging the jewel.

In installing, the meter should be secured to a solid perpendicular support and carefully leveled before connecting to the circuit.

To level the meter, remove the top cap, which seals the connections of the meter; this will give access to the leveling lug on the frame. The meter should be carefully leveled both ways. After leveling, connect the meter in circuit according to the diagram of its class.



SEPARATE SEALED PATTERN TYPE K METER.



ROTATING PARTS.

TESTING OF WATTMETERS.

It is often desirable to test wattmeters from time to time while they are installed. If a rough test is all that is required it can be made by turning on a specified number of lights, multiplying the number of lights by the watts per lamp to give the load on the meter, and by using the following standard formula:

$$\frac{\text{Revolutions} \times 100\ C}{\text{Seconds required to make revolutions}} = \text{Watts registered by meter.}$$

(C is a constant depending on the capacity of the meter. The value of C is given in the following table.)

If a stop watch is used, the only inaccuracy in the test will be the difference between the estimated and the actual watts per lamp.

If a more accurate test is required, a standard wattmeter may be used, such as a portable indicating instrument. By connecting the instrument in series with the meter it will read in watts, and by applying the above formula will give an absolute test.

An accurate test may also be made by the use of a number of lamps whose wattages are absolutely known for different voltages. These lamps can be connected as the only load on the meter, and by reading the voltage of the circuit at the point where the test is made, with a standard portable voltmeter, the load in watts may be determined. In this manner a direct comparison may be made.

TABLE OF VALUES OF CONSTANT C FOR DIFFERENT CAPACITY METERS.

Amperes.	C 50 Volts.	C 100 Volts.	C 220 Volts.	C 500 Volts.	C 1000 Volts.	C 2000 Volts.
3	.....	9	9	45	90	180
5	9	9	18	45	90	180
10	9	18	36	90	180	360
15	18	36	54	180	360	720
20	18	36	72	180	360	720
25	18	36	72	180	360	720
30	36	72	90	360	720	1440
40	36	72	108	360	720	1440
50	36	72	144	360	720	1440
60	54	108	180	540	1080	2160
75	54	108	216	540	1080	2160
100	72	144	288	720	1440	2880
125	90	180	360	900	1800	3600
150	108	216	432	1080	2160	4320
200	144	288	.....	1440	2880	5760
250	180	360	.....	1800	3600	7200
300	216	432	.....	2160	4320	8640
400	288	576	.....	2880	5760	11520
500	360	720	.....	3600	7200	14400
600	432	864	.....	4320	8640	17280
800	576	1152	.....	5760	11520	23040
1000	720	1440	.....	7200	14400	28800
1200	900	1800	.....	9000	18000	36000

READING OF METERS.

The counters of the meters for all capacities are direct reading, and record in kilowatt hours (1000 watt hours).

The figures (tenths 1s, 10s, 100s and 1000s) placed over each dial, represents the number of units registered by the passing of the hand from one number to the other. A complete revolution of the hand will produce a travel of one-tenth of a revolution on the next dial to the left.

By referring to counter No. 1 it will be seen that the hand of dial marked tenths has passed over 9 divisions and as the value of each division is a tenth of a kilowatt hour (100 watt hours) the reading of this dial is .9 kilowatt hours. The hand of dial marked 1s is pointing to 6, but as the hand of dial marked tenths has not completed its revolution the hand of dial marked 1s has not reached or past 6, hence its reading is 5 kilowatt hours. The hand of dial marked 10s is indicating between 6 and 7, hence its reading is 60 kilowatt hours. The hand of dial marked 100s has nearly reached zero but has not completed its revolution as the hand of dial marked 10s has passed but little over six-tenths of a revolution, hence the reading of dial marked 100s is 900 kilowatt hours. The hand of dial marked 1000s is pointing to 2, but has not reached 2 as the hand of dial marked 100s has not competed its revolution, hence the reading of dial marked 1000s is 1000 kilowatt hours.

By adding the reading of the different dials we obtain the total 1965.9 kilowatt hours.

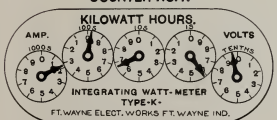
By referring to counter Nos. 2, 3 and 4, which are given as examples, and by following carefully the same method o

reading as given above, we obtain for counter No. 2—1282 kilowatt hours; counter No. 3—307260 kilowatt hours and for counter No. 4—9704500 kilowatt hours.

In taking the reading by the above method it will be noted that it is essential to consult the dial to the right in determining the correct position of the hand of the next dial to the left, hence it is advisable to read a counter from right to left.

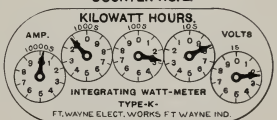
By following carefully the directions as outlined, no difficulty will be experienced in determining the correct reading of any counter. As no multipliers or constants are used on the type K wattmeter, the energy measured is read direct from the counter.

COUNTER NO. 1.



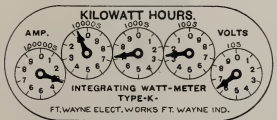
READING—1965.9 KILOWATT HOURS.

COUNTER NO. 2.



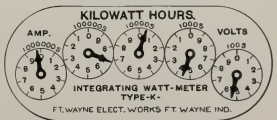
READING—1282 KILOWATT HOURS.

COUNTER NO. 3.



READING—307260 KILOWATT HOURS.

COUNTER NO. 4.



READING—9704500 KILOWATT HOURS.

REPAIR OF METERS.

In cases where the meter is damaged or much worn, it should be taken out of circuit, repaired and recalibrated. In preparing the meter for recalibration all parts should be carefully examined and cleaned. Benzine may be used in cleaning the registering mechanism and bearings. All worn or damaged parts should be replaced by new ones.

To facilitate in repairing, all parts are made standard and interchangeable.

The very best grade of clock oil should be used in oiling the different bearings. Do not oil the worm or shaft's top bearing.

The meter is so constructed that, by the removing of the top bearing stud and the bracket supporting the registering mechanism, the rotating parts may be removed. (See Fig. 3.) If the meter has been operating on a broken or very rough jewel, the shaft should be renewed. In the inserting of a new shaft care should be taken to note that the cup rests on the shoulder of the shaft before tightening the set screw.

In renewing the jewel bearing, screw the jewel in place until the jewel head jams firmly against the adjusted collar.

THE CHANGING OF THE BEARINGS WILL NOT CHANGE THE CALIBRATION OF THE METER.

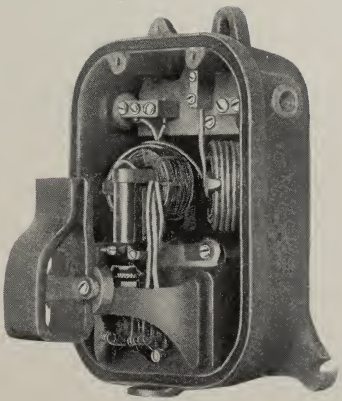


FIG. 3.

REGISTERING MECHANISM AND ROTATING PARTS REMOVED.

SPEED ADJUSTMENT.

In calibrating the meter the speed is adjusted by changing the position of the permanent magnet. Raising the magnet will decrease and lowering will increase the speed of the meter.

TO ADJUST THE SPEED ON LOW LOADS.

The meter is provided with a starting coil to overcome the static friction of the instrument and insure accurate registration on low loads. The position of the starting coil is adjusted by the screws A and B, Fig. 4.

The speed of the meter can be increased on light loads by slacking screw A and tightening screw B, and decreased by slacking B and tightening A.

DO NOT RELEASE SCREW C FIG. 5, IN MAKING THIS ADJUSTMENT.

WHEN PROPERLY ADJUSTED THE METER WILL REGISTER CORRECTLY ON LIGHT LOADS AND WILL NOT CREEP WHEN THE LOAD IS OFF. CHANGES OF 25 PER CENT. IN THE VOLTAGE FROM THE RATING OF THE METER WILL NOT IMPAIR THE ACCURACY OR CAUSE THE METER TO CREEP.

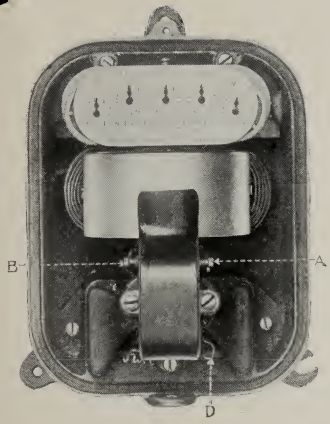


FIG. 4.

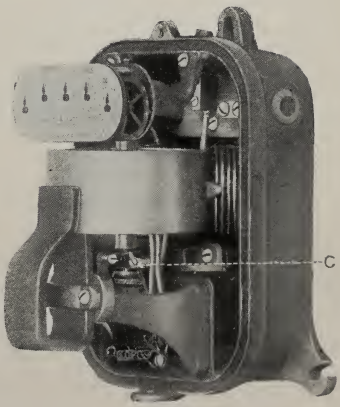


FIG. 5.

CHANGE OF FREQUENCY.

It is often desirable to change a meter adapting it to low frequency (60 cycles) circuit instead of high (125 to 140 cycles) or vice versa, without entailing a large loss of time and the usual expense in over-hauling, changing of parts and recalibrating. In the type K wattmeter this change can be made without taking the meter out of service by the soldering or unsoldering of one joint.

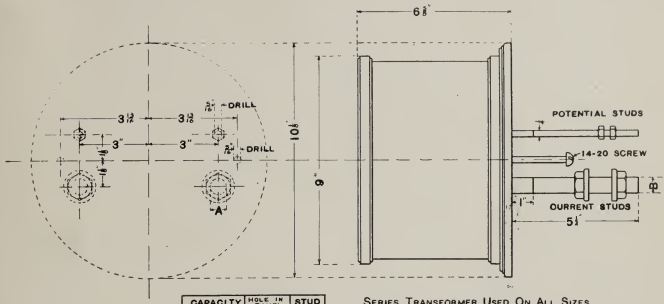
To change the meter from high frequency (125 to 140 cycles) to low frequency (60 cycles) close the circuit at D (Fig. 4) by soldering the joint. If it is desired to change the meter from low frequency to high open the circuit at D. After making this change, the speed of the meter should be taken. If not correct, the position of the permanent magnate should be adjusted.

CARRYING CAPACITY OF METER.

The meter will safely carry a 50 per cent. overload when the load is not retained for any great length of time.

LOCATION OF METERS.

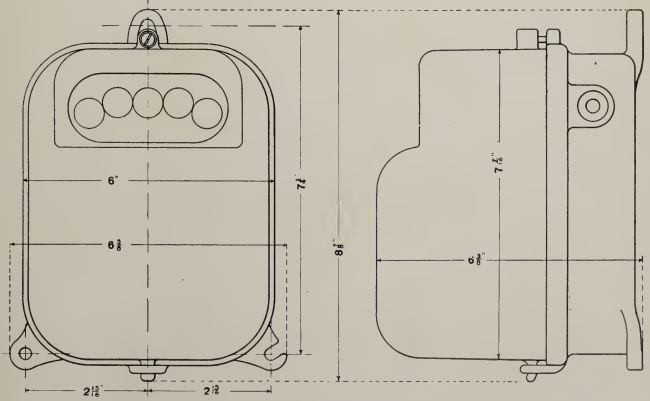
Care should be taken in installing meters to place them in positions where they are subject to the least vibration. Avoid extremely hot or damp locations, and places subject to steam, or chemical fumes, as these are conditions that would tend to reduce the durability and satisfactory operation of the meter.



CAPACITY IN AMPERES	HOLE IN PANEL A	STUD B
5 TO 150	⅝	¼
200 TO 300	1⅛"	1⅛"

SERIES TRANSFORMER USED ON ALL SIZES ABOVE 300 AMPERES. CURRENT STUDS SAME AS FOR 5 TO 150 AMPS.

DIMENSIONS OF SWITCHBOARD PATTERN TYPE K METER.



GENERAL DIMENSIONS

TYPE-K-INTEGRATING WATTMETER

Name .....

Location .....

Constant ..... **Meter No** .....

Type ..... **Amps** ..... **Volts** .....

DATE ..... READ BY ..... READING .....

DATE ..... READ BY ..... READING .....

DATE ..... READ BY ..... READING .....

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PAGE FROM METER READING BOOK.

DIAGRAMS

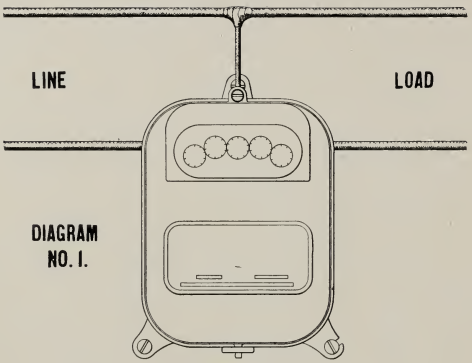
OF

CONNECTIONS

FOR

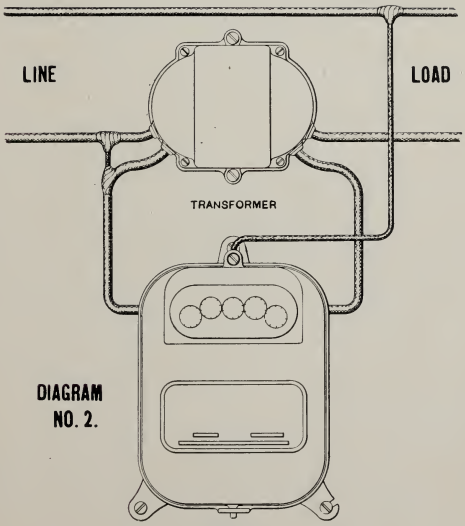
TYPE K INTEGRATING

WATTMETER.



CONNECTIONS FOR
TYPE - K - INTEGRATING WATT-METER.
TWO WIRE

3 TO 300 AMPERES
50 TO 220 VOLTS



CONNECTIONS FOR
TYPE · K · INTEGRATING WATT-METER

CURRENTS EXCEEDING 300 AMPERES
50 TO 220 VOLTS.

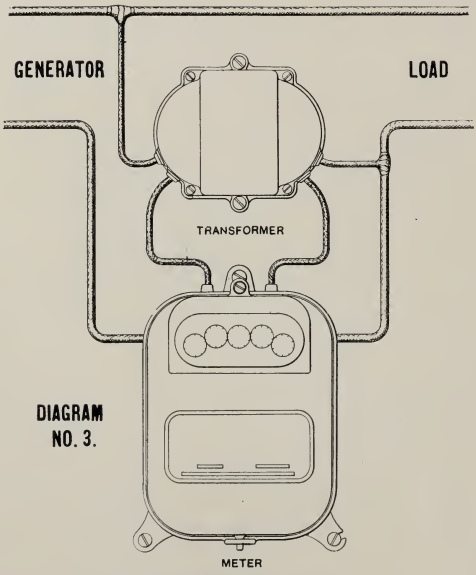


DIAGRAM NO. 3.

CONNECTIONS FOR TYPE · K · INTEGRATING WATT-METER

PRIMARY CIRCUITS — 3 TO 300 AMPERES.

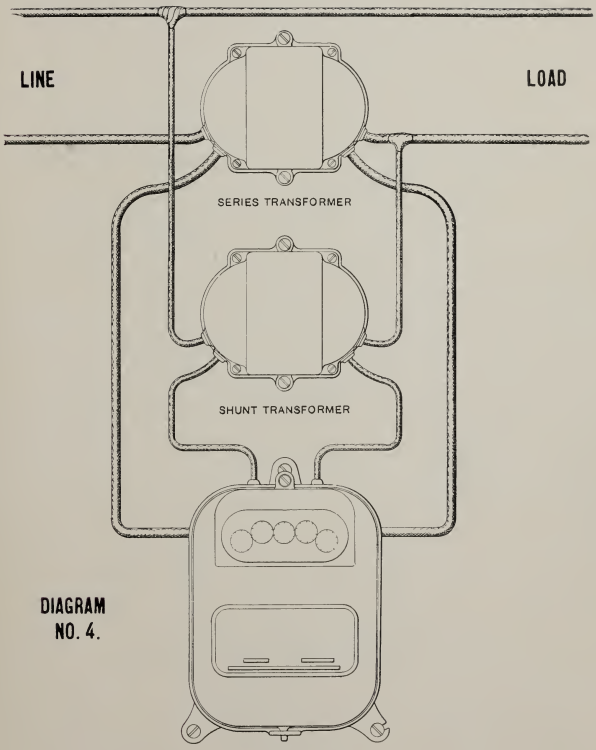
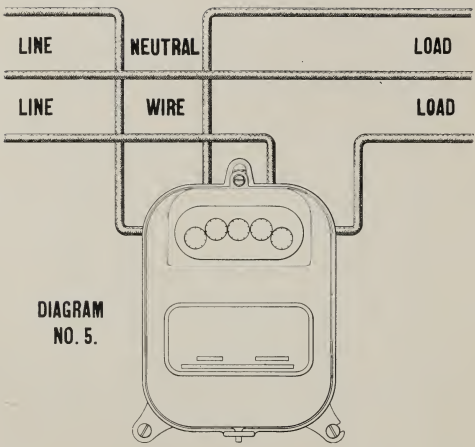


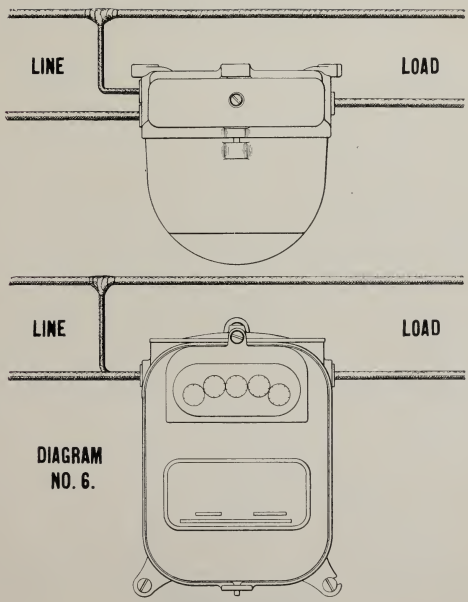
DIAGRAM
NO. 4.

CONNECTIONS FOR
TYPE - K - INTEGRATING WATT-METER

CURRENTS EXCEEDING 300 AMPERES
PRIMARY CIRCUITS



CONNECTIONS FOR
TYPE - K - INTEGRATING WATT-METER.
THREE WIRE
3 TO 150 AMPERES
220 VOLTS



CONNECTIONS FOR
TYPE - K - INTEGRATING WATT-METER

SEPARATE SEALED CONNECTIONS
3 TO 300 AMPERES — 50 TO 220 VOLTS

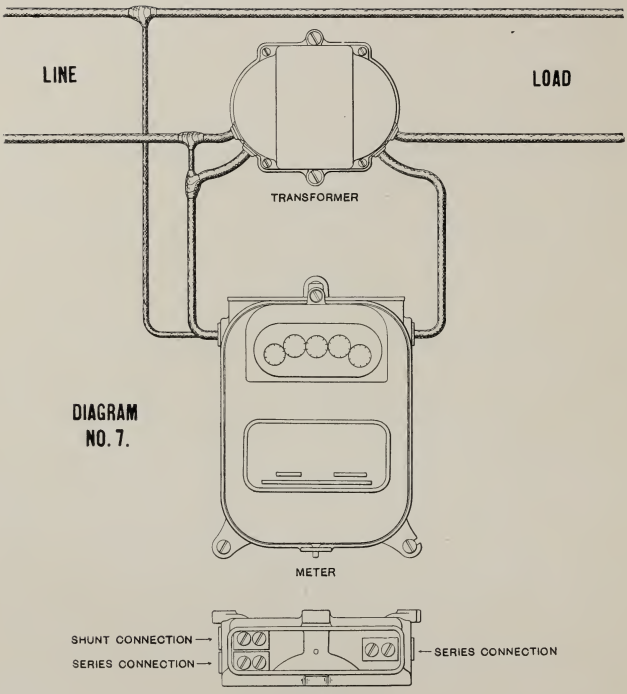


DIAGRAM
NO. 7.

CONNECTIONS FOR
TYPE - K - INTEGRATING WATT-METER

SEPARATE SEALED CONNECTIONS
CURRENTS EXCEEDING 300 AMPERES
50 TO 220 VOLTS

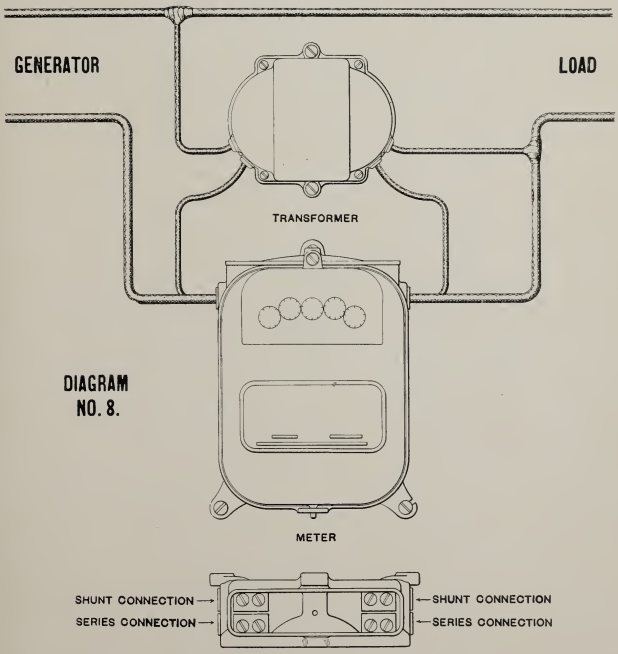


DIAGRAM
NO. 8.

CONNECTIONS FOR
TYPE - K - INTEGRATING WATT-METER

SEPARATE SEALED CONNECTIONS
PRIMARY CIRCUITS. – 3 TO 300 AMPERES

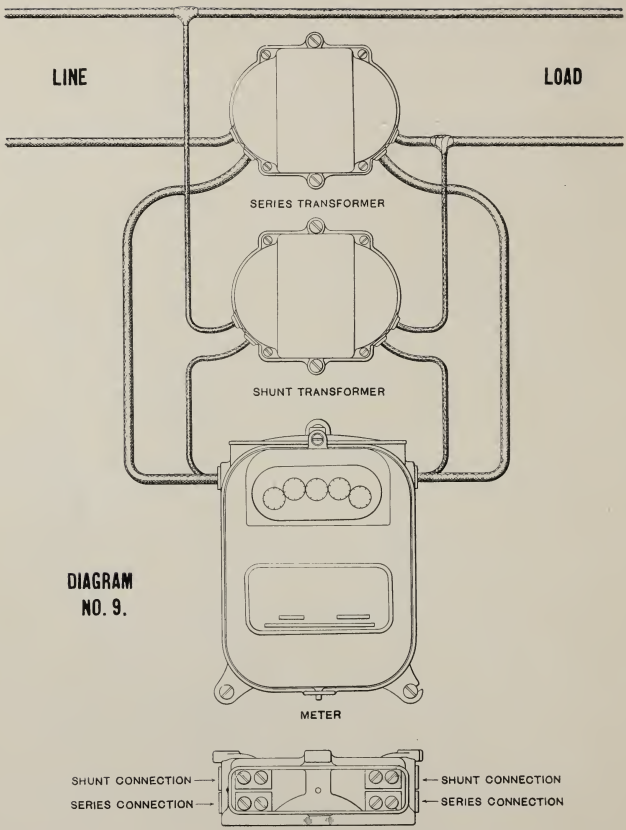


DIAGRAM
NO. 9.

CONNECTIONS FOR
TYPE - K - INTEGRATING WATT-METER

PRIMARY CIRCUITS
CURRENTS EXCEEDING 300 AMPERES
SEPARATE SEALED CONNECTIONS

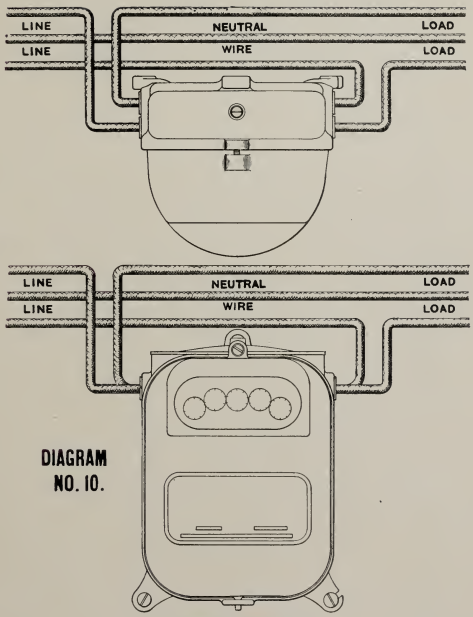


DIAGRAM
NO. 10.

CONNECTIONS FOR
TYPE -K- INTEGRATING WATT-METER.

THREE WIRE.- SEPARATE SEALED CONNECTIONS
3 TO 150 AMPERES. — 220 VOLTS.

TYPE K INTEGRATING WATTMETERS.

For Alternating Currents.

SINGLE PHASE.

Lamp Rating based upon 50 Watt Lamps.

FOR 50 VOLT CIRCUITS.

2 WIRE.

5	16 c. p.	Lamps	Capacity or	5	Amperes
10	"	"	"	10	"
15	"	"	"	15	"
20	"	"	"	20	"
25	"	"	"	25	"
30	"	"	"	30	"
40	"	"	"	40	"
50	"	"	"	50	"
60	"	"	"	60	"
75	"	"	"	75	"
100	"	"	"	100	"
125	"	"	"	125	"
150	"	"	"	150	"
200	"	"	"	200	"
250	"	"	"	250	"
300	"	"	"	300	"
400	"	"	"	400	"
500	"	"	"	500	"
600	"	"	"	600	"
800	"	"	"	800	"
1000	"	"	"	1000	"
1200	"	"	"	1200	"

FOR 100 VOLT CIRCUITS.

2 WIRE.

5	16 c. p.	Lamps	Capacity or	3	Amperes.
10	"	"	"	5	"
20	"	"	"	10	"
30	"	"	"	15	"
40	"	"	"	20	"
50	"	"	"	25	"
60	"	"	"	30	"
80	"	"	"	40	"
100	"	"	"	50	"
120	"	"	"	60	"
150	"	"	"	75	"
200	"	"	"	100	"
250	"	"	"	125	"
300	"	"	"	150	"
400	"	"	"	200	"
500	"	"	"	250	"
600	"	"	"	300	"
800	"	"	"	400	"
1000	"	"	"	500	"
1200	"	"	"	600	"
1600	"	"	"	800	"
2000	"	"	"	1000	"
2400	"	"	"	1200	"

FOR 200 VOLT CIRCUITS.

2 WIRE.

3	Amperes.	125	Amperes.
5	"	150	"
10	"	200	"
15	"	250	"
20	"	300	"
25	"	400	"
30	"	500	"
40	"	600	"
50	"	800	"
60	"	1000	"
75	"	1200	"
100	"		

FOR 220 VOLT CIRCUITS.

3 WIRE.

12	16 c. p.	Lamps	Capacity	or	3 Amperes.
20	"	"	"		5 "
40	"	"	"		10 "
60	"	"	"		15 "
80	"	"	"		20 "
100	"	"	"		25 "
120	"	"	"		30 "
160	"	"	"		40 "
200	"	"	"		50 "
240	"	"	"		60 "
300	"	"	"		75 "
400	"	"	"		100 "
500	"	"	"		125 "
600	"	"	"		150 "

500 VOLT POWER CIRCUITS.

INCLUDING TRANSFORMER.

2 WIRE.

3	Amperes.	125	Amperes
5	"	150	"
10	"	200	"
15	"	250	"
20	"	300	"
25	"	400	"
30	"	500	"
40	"	600	"
50	"	800	"
60	"	1000	"
75	"	1200	"
100	"		

The above Meters are made for 60 cycles (7,200 Alternations) and 125 to 140 cycles, (15,000 to 16,800 Alternations.)

TYPE K INTEGRATING WATTMETERS.

For Alternating Currents.

SINGLE PHASE.

FOR PRIMARY CIRCUITS.

INCLUDING TRANSFORMER.

1,000 VOLTS.	2,000 VOLTS.
3 Amperes.	3 Amperes.
5 "	5 "
10 "	10 "
15 "	15 "
20 "	20 "
25 "	25 "
30 "	30 "
40 "	40 "
50 "	50 "
60 "	60 "
75 "	75 "
100 "	100 "
125 "	125 "
150 "	150 "
200 "	200 "
250 "	250 "
300 "	300 "
400 "	400 "
500 "	500 "
600 "	600 "
800 "	800 "
1000 "	1000 "
1200 "	1200 "

The above Meters are made for 60 cycles (7,200 Alternations) and 125 to 140 cycles (15,000 to 16,800 Alternations).

Formula for 100^{v}.6 ampere lamps:

$$\frac{833.33}{\text{No. of lamps} \times \text{Single Distance.}} = \text{R per 1,000 ft. of required wire, at 1 per cent. loss.}$$

Formula for any lamp:

$$\frac{V}{C \times L} = \text{R per foot of required wire:}$$

V being permissible loss in volts,
C being current, and
L being total length in feet.

Formula for 50^{v} 1^{a} lamps at 2 per cent. loss:

$21 \times D \times C$ = Cir. Mils. of required wire.

D being single distance in feet, and
C being current in amperes.

Formula for $1{,}000^{v}$ primary circuit:

$$\frac{\text{Current} \times 21 \times \text{Single Distance in feet}}{\text{Loss in volts.}} = \text{Cir. Mils. of required wire.}$$

N. B.—A simple rule for quickly arriving at the approximate sizes of wire for primary circuits of 1,000 volts, reducing to 50 volts in the secondary, for usual loss, is:

$$\frac{\text{Lamp-feet}}{20} = \text{Cir. Mils. of required wire.}$$

Examples.—Required the size of wire for 250 lamps of 50 volts, 2000 feet away.

$$\frac{250 \times 2{,}000}{20} = \frac{500{,}000}{20} = 25{,}000 \text{ Cir. Mils., or nearly No. 6.}$$

What size wire is necessary to carry current for 500 lamps 2,500 feet?

$$\frac{2{,}500 \times 500}{20} = \frac{1{,}250{,}000}{20} = 62{,}500 \text{ Cir. Mils., or nearly No. 2.}$$

SECONDARY WIRING TABLE.

For 100 Volt Lamps. Two per cent. Loss.

Distance in Feet to Centre of Distribution.

No. OF 16 C. P. LAMPS.	20	30	40	50	60	70	80	90	100	120	140	160	180	200	SIZE OF WIRE, B. & S. GAUGE.
1	16	16	16	16	16	16	16	16	16	16	16	16	16	16	
2	16	16	16	16	16	16	16	16	16	16	16	16	16	16	
3	16	16	16	16	16	16	16	16	16	16	14	14	14	14	
4	16	16	16	16	16	16	16	16	16	14	14	14	12	12	
5	16	16	16	16	16	16	16	14	14	14	12	12	12	12	
6	16	16	16	16	16	14	14	14	14	14	12	12	10	10	
7	16	16	16	14	14	14	14	14	12	12	12	10	10	10	
8	16	16	14	14	14	14	14	12	12	12	10	10	10	8	
9	16	16	14	14	14	14	12	12	12	10	10	10	10	8	
10	14	14	14	12	12	12	12	12	12	10	10	10	8	6	
12	14	14	14	12	12	12	12	10	10	10	10	8	8	6	
14	14	14	12	12	12	12	10	10	10	10	8	8	8	6	
16	14	14	12	12	12	10	10	10	8	8	8	8	6	6	
18	12	12	12	12	10	10	10	10	8	8	8	6	6	6	
20	12	12	12	10	10	10	10	8	8	8	6	6	6	4	
25	12	12	10	10	8	8	8	8	8	6	6	6	4	2	
30	10	10	10	10	8	8	8	6	6	6	4	4	4	1	
40	10	10	8	8	8	6	6	6	6	4	4	4	2	0	
50	8	8	6	6	6	6	6	4	4	2	2	1	0	0	

SECONDARY WIRING TABLE.

For 50 Volt Circuits. Two per cent. Loss.

Distance in Feet to Centre of Distribution.

SIZE OF WIRE, B. & S. GAUGE.

No. of 16 C. P. Lamps.	20	30	40	50	60	70	80	90	100	120	140	160	180	200
1	16	16	16	16	16	16	16	16	16	16	14	14	14	13
2	16	16	16	16	16	14	14	14	13	12	12	12	11	10
3	16	16	16	14	14	12	12	12	12	11	10	10	8	8
4	16	16	14	12	12	12	10	10	10	10	8	8	8	6
5	16	14	12	12	12	10	10	10	10	8	8	8	6	6
6	16	14	12	12	10	10	10	10	8	8	8	6	6	6
7	14	12	12	10	10	10	8	8	8	8	6	6	6	4
8	14	12	12	10	10	8	8	8	8	6	6	6	4	4
9	14	12	10	10	8	8	8	8	6	6	6	4	4	4
10	14	12	10	10	8	8	8	6	6	6	4	4	4	4
12	12	10	10	8	8	8	6	6	6	4	4	4	4	3
14	12	10	8	8	6	6	6	6	4	4	4	3	3	2
16	12	10	8	8	6	6	6	4	4	4	3	3	2	2
18	10	8	8	6	6	6	4	4	4	3	3	2	2	1
20	10	8	8	6	6	4	4	4	4	3	2	2	1	1
25	10	8	7	6	4	4	4	3	3	2	1	1	0	0
30	8	8	6	4	4	4	3	3	2	2	1	0	00	00
40	8	6	4	4	3	2	2	1	1	0	00	00	000	000
50	6	4	4	3	2	1	1	0	0	00	000	000	0000	0000

INDEX

FOR INSTRUCTION BOOK

No. 3004.

	PAGES.
General statements	3-4
Instructions for installing standard from type K meter	6
Instructions for installing separate sealed meter	8
Testing of wattmeter	10-11
Reading of meters	12-13
Repairing of meters	14
Speed adjustment	16
Low load adjustment	16
Change of frequency	18
Carrying capacity	18
Location of meters	18
Dimensions of switchboard pattern	19
General dimensions of meter	19
Page from meter reading book	20
Connections for 2 wire meters, currents from 3 to 300 amperes	22
Connections for 2 wire meters, currents exceeding 300 amperes	23
Connections for primary meters, currents from 3 to 300 amperes	24
Connections for primary meters, currents exceeding 300 amperes	25
Connections for 3 wire meters, currents from 3 to 150 amperes	26
Connections for 2 wire meters, separate sealed, currents from 3 to 300 amperes	27
Connections for 2 wire meters, separate sealed, currents exceeding 300 amperes	

Connections for primary meters, separate sealed, currents from 3 to 300 amperes 29
Connections for primary meters, separate sealed, currents exceeding 300 amperes 30
Connections for 3 wire meters, separate sealed, currents from 3 to 150 amperes 31
Capacities of 2 wire 50 volt meters 32
Capacities of 2 wire 100 volt meters 32
Capacities of 2 wire 200 volt meters 33
Capacities of 3 wire 220 volt meters 33
Capacities of 2 wire 500 volt meters 33
Capacities of primary meters, 1000 and 2000 volts . . . 34
Wiring formula 35
Secondary wiring table for 100 volt circuits 36
Secondary wiring table for 50 volt circuits 37

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